Routledge
Taylor & Francis Group

Agrekon

Agricultural Economics Research, Policy and Practice in Southern Africa

ISSN: 0303-1853 (Print) 2078-0400 (Online) Journal homepage: www.tandfonline.com/journals/ragr20

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To cite this article: Chiedza L. Muchopa, Yonas T. Bahta & Abiodun A. Ogundeji (2019) Tariff rate quota impacts on export market access of South African fruit products into the EU market, Agrekon, 58:4, 426-450, DOI: 10.1080/03031853.2019.1593865

To link to this article: https://doi.org/10.1080/03031853.2019.1593865

AGREKON
2019, VOL. 58, NO. 4, 426–450
https://doi.org/10.1080/03031853.2019.1593865

Tariff rate quota impacts on export market access of South African fruit products into the EU market

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ABSTRACT

In this paper tariff rate quota (TRQ) fruit products are analysed as representative sectors in a Global Trade Analysis Project (GTAP) Computable General Equilibrium (CGE) static model to establish impacts on trade and welfare. Simulations are carried out to remove EU tariffs on fruit products, non-tariff measures (NTMs) and other influential factors accounting for the unfilled portion of the TRQs. A large proportion of quota under-fill is explained by the presence of NTMs which include aspects of the TRQ administration methods on the exporter side. The results of the simulations show that the increase in exports is greater with the removal of NTMs than with tariff removal. The findings of the equivalent variation (EV) measure of welfare show a welfare loss of –US $14 040 in South Africa when quota fill is simulated without the removal of NTMs. Partial trade liberalisation characterised by the removal of only tariffs, exhibits smaller welfare gains (US$31 943) compared with the combined liberalisation of tariffs and NTMs which improves welfare by US$221 834. The study concludes that the trade liberalisation process of fruit products TRQs should simultaneously implement full tariff liberalisation with TRQ expansion and the reduction of NTMs.

KEYWORDS

tariff rate quota; welfare analysis; Trade; Development and Cooperation Agreement; GTAP

JEL Classification

C68; F13; F17; O55; F15

1. Introduction

Access barriers to the European Union (EU) market of fruit and fruit products have been of concern to South African exporters, policymakers and stakeholders that include fruit sector representative associations. South Africa and the EU implemented the Trade, Development and Cooperation Agreement (TDCA), a bilateral trade agreement for the period 1999 to 2016. As part of an effort to address export market access barriers, the TDCA has a trade chapter which sets out the framework of tariff rate quota (TRQ) concessions. A TRQ is a trade policy instrument for which a low in-quota tariff is charged for quantities exported within a given quota and a high out-of-quota tariff applies to quantities above the guaranteed quota level. Within this framework, the EU grants fruit products TRQs to South Africa on a preferential basis.

The fruit products TRQ concessions implemented under the TDCA have since the end of 2016 been moved to the recently signed Southern African Development Community – European Union – Economic Partnership Agreement (SADC-EU-EPA). The SADC-EU-EPA covers the trade relationship between the EU and the SADC-EPA group (Botswana, Lesotho, Namibia, Mozambique, Swaziland and South Africa). South Africa, however, still enjoys preferential market access to the EU for fruit products. The same fruit products TRQs as had obtained under the TDCA are granted to South Africa under the SADC-EU-EPA. TRQ administration is the responsibility of the exporting country and the administration of fruit products TRQs by South Africa is further elaborated is Section 2.1.

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Research by scholars (Barichello, 2000; Pouliot and Larue, 2012) contributing to the export market access debate has highlighted the existence of challenges of the ineffectiveness of TRQs as instruments of trade liberalisation leading to quota under-fill. An emerging reality under the TDCA is that most of the EU fruit products TRQs extended to South Africa are not filled. Various reasons can be advanced for the under-filled quotas and some underlying factors that include the TRQ administration frameworks, actual quota quantities, in-quota tariff levels and other associated non-tariff measures (NTMs) are seen as contributors to quota under-fill.

The quota component of the TRQ is a non-tariff measure (NTM) which under the TDCA is employed as a trade policy tool. Nimenya *et al.* (2012) describe NTMs as all government imposed international trade restricting measures other than tariffs or customs taxes. NTMs as defined in Beghin and Xiong (2016) cover the expansive sets of policy instruments from border control measures, marketing requirements and product standards. The EU sets some sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBT) that occasionally present barriers to accessing the EU market. The Citrus Growers Association of Southern Africa (2011) notes, for example, that citrus black spot (CBS) measures imposed by the EU are unnecessarily harsh. CBS is a fruit disease affecting the skin of the fruit and is known to be harmless to consumers.

The full utilisation of TRQs also depends on market signals. Monnich (2003) identifies demand as a probable cause for quota under-fill and notes that low demand can result temporarily, but links consistently to a situation that can result from the TRQ product definition being too narrow. For quotas that are not filled, the question asked is whether under-fill is occurring due to the fact that there has not been enough domestic demand from the EU market under the prevailing market conditions or that there are other influential factors. More detailed information regarding the demand and supply situation of fruit/fruit products between South Africa and the EU is presented in Section 2.3.

Besides tariffs, there are other influential factors (elaborated in Sections 4.1.2 and 4.1.3) behind the reason why the quota remains under-filled. NTMs are among the influential factors to quota fill and are a trade cost. Such a trade cost is therefore an addition to the in-quota tariff affecting tariff quota fill. The under-fill and over-fill situations have generated interest in policymakers and trade negotiators to unpack the drivers of such phenomena. Over-filled quotas generally imply that exporters have more capacity but are bound by the quota quantities set by the importing country.

In contribution to the debate on NTMs, this paper assesses the influence of NTMs in quota fill of fruit/fruit products TRQs. The analysis is based on simulations in the Global Trade Policy Analysis (GTAP) model discussed in Section 4.6. An interesting question to which the paper also seeks some answers in addition to NTMs, concerns the extent to which exporters perceive aspects of the TRQ administration framework to be a fundamental driver in export market access of fruit products. In this regard experiences of exporting establishment and key informants are also sought with respect to the role of associated NTMs in enhancing or constraining the capacity of exporting establishments to fill quotas. In this context the paper advances a discussion of the influential factors to TRQ fill in the realm of NTMs associated with export market access of fruits/fruit products (discussed in Section 4.1.3).

Drawing on empirical results in a GTAP computable general equilibrium (CGE) model framework with an aggregation of sectors and countries built bespoke for the relevant fruit product TRQ analysis, the paper argues that partial fruit TRQ liberalisation weakens the potential gains in export market access of the EU market by South Africa. Culminating from the analysis of the decomposition of the model welfare results, insights into the scenarios enabling the largest gains occurrence are provided. The paper makes recommendations on the liberalisation of TRQs.

Well known approaches to modelling NTMs in a GTAP model involve introducing an NTM via the power of the tariff based on a calculated tariff equivalent and secondly on the iceberg approach. The iceberg approach models the reduction of NTMs through shocking a technology parameter that reduces trade costs in the GTAP model. This study adopts the iceberg approach to modelling NTMs in the GTAP model and modifies the basis upon which the shock size is calculated. The calculated shock size incorporates the proportion of NTMs measure of influence to fill fruit products TRQs

(detailed in Section 4). Furthermore, to enrich the discussion on influential factors to quota fill, the study simulates quota fill of fruit TRQs by introducing a shock via the export demand variable. The shock to the export demand variable is calculated as the proportion that accounts for the unfilled portion of the quota and required to fill the TRQ.

2. The context: TRQ Implementation framework, NTMs associated with fruit products exports, supply and demand

2.1 Brief review of the implementation framework of fruit TRQs

The administration of TRQs mainly centres on the allocation of the yearly available quota to the prospective exporter. The Department of Agriculture, Forestry and Fisheries (DAFF) is the institution in South Africa which is tasked with the administration of the fruit products TRQs. DAFF works closely with the South African Fruit and Vegetable Canners Association (SAFVCA) and the South African Fruit Juice Association (SAFJA) that assist in the assessment of quota utilisation and administration. Under the administration mechanism, exporters receive permits for fruit TRQ exports to the EU on an annual basis. Government *Gazettes* are utilised as a platform to publish the quota availability as well as the relevant details of the TRQ administration mechanism for fruit/fruit products under the TDCA. The same fruit products TRQs are now administered under the SADC-EU-EPA by DAFF and the same administration procedures as under the TDCA are applied.

The six fruit products TRQs of the TDCA administered through DAFF cover the export of 33 fruit products tariff lines (Table 1). The tariff lines are defined at the Harmonised Commodity Description and Coding System (HS) 8-digit level at which concessions have been negotiated. In the broad HS 4-digit level groups, canned fruit tariff lines (HS2008) and fruit juice tariff lines (HS2009) have been granted the preferences under the TDCA and are modelled in this study at the HS 6-digit level as detailed in Section 4.2. For purposes of this study the tropical and non-tropical fruit mixtures TRQs are classified under the same HS 6-digit level and are analysed as a single canned fruit mixture TRQ. Five, instead of six, TRQs are subsequently referred to in the analysis. The tariff rates set out in the trade agreement for tariff lines in each of the six TRQs are presented in Table 1.

The TDCA tariff rates for frozen orange juice, canned pears, apricots and peaches, canned fruit mixtures, as well as apple and pineapple juice TRQs, are 50 per cent lower than the most favoured nation (MFN) rate that is implemented on out of quota imports. In accordance with the provisions of the TDCA, these rates apply for the years 2011 to 2016 considered for this study. The frozen strawberries in-quota tariff rate is a concession of 100 per cent of the MFN rate. Despite this concession, South Africa has recorded zero exports under the frozen strawberries TRQ.

The Trade Permit System utilised by DAFF details the considerations made in the allocation of permits but the actual calculations for sharing the quotas are not published in the gazetted notice of available quotas. The actual calculations are, however, available from DAFF and are known by the relevant umbrella associations. At the time of application, the applicants are not notified of their due share of the allocation. The Broad Based Black Economic Empowerment (BBBEE) point scoring system is part of the allocation criteria and it is explained as a way to increase export participation opportunities for businesses owned by historically disadvantaged exporters as well as to increase participation of newly established businesses. Table 2 shows 2013 records gathered from DAFF on the number of applicants, their category, and share of quota applied for and received.

The exporter can potentially receive the least or no allocation depending on their level of BBBEE compliance. The allocation based on BBBEE points was designed to rationalise market access within the South African agricultural environment but with adverse impacts on the filling of quotas. The system indirectly or unintentionally limits the quota granted to those exporters with capacity on the basis of BBBEE non-compliance. The available information as exemplified for the pears, apricots and peaches TRQ in Table 2, indicates that the historically advantaged big exporting companies have not been fully receiving their requested quota allocation.

Table 1. Tariff rates per order number of the TRQs.

	Broad commodity description HS6-digit code	8-digit CN code(s)	TDCA preferential in-quota tariff rate (%); 2011-2016	Erga omnes (MFN) duty (%); 2011-2016	Concession level in 2011 (kg)
TRQ	Frozen strawberries HS0811.10	0811.10.90	0	14.4	332 500
TRQ	Canned pears	2008.40.51	19.1	17.6	54 682 250
	HS2008.40	2008.40.59	8.3	16.0	
		2008.40.71	10.0	19.2	
		2008.40.79	9.1	17.6	
		2008.40.90	8.7	16.8	
	Canned apricots	2008.50.61	10.0	19.2	
	HS2008.50	2008.50.69	9.1	17.6	
		2008.50.71	10.8	20.8	
		2008.50.79	10.0	19.2	
		2008.50.92	7.1	13.6	
		2008.50.98	8.5	17.0	
	Canned peaches	2008.70.61	10.0	19.2	
	HS2008.70	2008.70.69	9.1	17.6	
		2008.70.71	10.1	19.2	
		2008.70.79	9.1	17.6	
		2008.70.92	7.9	15.2	
		2008.70.98	9.5	18.4	
TRQ	Non-tropical mixtures of canned fruit	2008.97.59	9.1	17.6	27 011 400
	HS2008.97	2008.97.74	7.1	13.6	
		2008.97.78	10.0	19.2	
		2008.97.98	9.6	18.4	
TRQ	Tropical mixtures of canned fruit HS2008.97	2008.97.72	4.9	8.5	
TRQ	Frozen orange juice HS2009.11	2009.11.99	7.9	15.2	931 000
TRQ	Pineapple juice	2009.41.92	7.9	15.2	6 650 000
	HS2009.41	2009.49.30	7.9	15.2	
	HS2009.49				
	Apple juice	2009.71.20	9.0	18.0	
	HS2009.71	2009.71.99	9.0	18.0	
	HS2009.79	2009.79.11	15.0 + 9.80Eur/100kg	30.0 + 18.40Eur/100kg	
		2009.79.19	15.0	30.0	
		2009.79.30	9.0	18.0	
		2009.79.91	9.0 + 10.20Eur/100kg	18.0 + 19.30Eur/100kg	
		2009.79.98	9.0	18.0	

Source: Author's compilation based on TARIC database.

Two rounds of allocations ensue wherein, in the first round the applicants get equal allocations within their respective BBBEE rated levels. The surplus or remaining quota is then reallocated in the second round including to the BBBEE non-compliant applicants. Due to uncertainty leading to the time of the reallocation period, quota applicants make alternative decisions to export their stock/output to other existing destinations. Consequently the allocated TDCA fruit products export permits are under-utilised. In this instance it is plausible to suggest that the inability to fill TRQs is not attributable to the lack of supply, demand or tariff levels since the permit allocation and TRQ administration system presents obstacles to quota fill. It is reported in Hasha (2004) and CBI (2015) that the EU is deficit in most fruit and vegetables under the EU import regime which focuses on prices. The EU demand exists (especially in the newer EU states) to fulfil the required imports of fruit and vegetables at the desired prices. The TDCA fruit TRQs therefore assure preferential market access. Preferential arrangements as obtained under the TDCA naturally divert trade from the EU's MFN trading partners.

Table 2. TDCA fruit products quota allocation to applicants in 2013.

Products, HS codes and notified quota in kg	Category of Applicant and applicant ID	Quota requested/applied for as a share (%) of notified quota	Quota allocated/received as a percentage of quota requested
Frozen strawberries HS0811.10; 347 500 kg	n/a	0	0
Orange juice frozen	Historical[a] exporter A	102.77	64.70
HS2009.11.99; 973 000 kg	Combined[b] exporter B	30.83	92.33
Canned fruit (pears, apricots	Historical exporter H	100.77	56.46
and peaches)	Historical exporter I	100.77	22.72
HS2008.40/.50/.70;	Combined exporter J	2.10	100.00
57 155 750 kg	Combined exporter K	2.62	100.00
	Combined exporter L	4.37	100.00
	Combined exporter F	5.60	100.00
Mixed fruit	Combined exporter L	0.89	100.00
HS2008.97.59/.74/.78/.98;	Historical exporter H	88.55	47.86
28 231 800 kg	Historical exporter I	90.85	46.65
Apple juice	Historical exporter D	28.78	100.00
HS2009.71.20/.99;	Combined exporter E	14.39	41.80
2009.79.11/.19/.30/.91/.98;	Combined exporter A	8.63	69.67
6 950 000 kg*	Combined exporter F	0.10	83.60
Pineapple juice	Combined exporter A	47.50	0.10
HS2009.41.92.10/.20/.30			

Source: DAFF and own calculations.
Notes:
*TRQ amount also includes the pineapple juice.
[a] Historical means exporters with three or more years export history, are applying for large quantities.
[b] Combined exporter refers to exporters/companies that have markets share history of less than three years and are applying for small quantities.

2.1.1 TRQ fill rates

Given that fruit TRQs have generally not been filled by South African exporters under the TDCA, the fill rates of the fruit TRQs could be an indicator that gives insight into the extent to which certain influential factors (discussed in Sections 2.2, plus Sections 4.1.2 and 4.1.3) reduce the preferential market access. In Table 3, fill rates of the notified quotas are indicated.

Fruit products TRQ data in Table 3 shows that for the years 2011, 2012 and 2016 analysed, there is under-fill for all quotas except frozen orange juice in 2016. The proportion to which the South African exporters are able to fill the fruit TRQs has generally declined for all TRQs except for frozen orange juice where fill rates have increased. The apple, pineapple juice sector which is the most protected sector has shown the greatest decline in the fill rates to meagre proportions of below 10% in 2016 from a fill proportion of 50% in 2011. The notified TRQ levels therefore are not an instantaneous limiting factor to the level of market access. The exporters are not exporting at maximum allowable quotas. The unfilled quota percentages which represent the shortfalls in filling a TRQ, indicate the extent of effect of influential factors to quota fill. If the influences to quota fill are removed, the quota levels potentially become limiting when over-fill occurs. Section 2.2 further elaborates on some of the influential factors in the form of NTMs associated with quota under-fill.

Table 3. Notified TRQ and fill proportion of the TRQ (2011, 2012 and 2016).

	2011		2012		2016	
Fruit TRQ	Notified TRQ level (kg)	Fill proportion (%)	Notified TRQ level (kg)	Fill proportion (%)	Notified TRQ level (kg)	Fill proportion (%)
Frozen orange juice	931 000	0.55	952 000	0.86	1 036 000	0.99
Canned pears, apricots and peaches	54 682 250	0.74	55 919 000	0.67	60 866 000	0.49
Frozen strawberries	332 500	0.0	340 000	0.0	370 000	0.0
Apple, pineapple juice	6 650 000	0.50	6 800 000	0.17	7 400 000	0.06
Canned fruit mixtures	27 011 400	0.20	27 621 600	0.16	30 062 400	0.07

Source: TARIC database and author calculations.

2.2 Forms of NTMs associated with South Africa's fruit TRQ exports to the EU

As eluded to in Beghin and Xiong (2016), there are diverse policies that are the basis of standard-like NTMs. Such standard-like NTMs are also noted as characterising the TRQ policy instrument which is relevant for the fruit products under the TDCA. Besides the standard-like NTMs, the TRQ in itself has a quota component that is already a non-tariff measure. In addition to the NTMs imposed through TRQ administration methods discussed in Section 2.1, some forms of NTMs such as the rules of origin, sanitary and phytosanitary (SPS) measures as well as marketing requirements also act as barriers to quota fill. The fruit products exported to the EU from South Africa are affected by one or more NTMs. Protocol 1 of the TDCA sets out the rules of origin concerning the application of tariff preferences of the agreement. In general a certificate of movement must accompany the South African consignments to the EU proving the origin status.

This study demarcates four categories of influential factors to TRQ fill relevant to South African fruit products exports. The influential factors are grouped on the basis of TRQ administration methods, TRQ definition and use conditions, TRQ supply and demand conditions as well as TRQ tariff level conditions. The specific aspects under each of the categories are analysed in Section 4.1.3. Most of the listed aspects of influential factors to quota fill are in the category of NTMs.

The TDCA is highlighted amongst what Kareem (2011) terms the EU's special preference arrangements significant for African exports. South African exporters of fruit products must comply with standards of exports to the EU market in order to benefit from the preferential arrangements. The EU Parliament (2011) note that SPS measures include standards on additives, disease causing organisms and residues of pesticides in food. Some of the SPS measures affecting South African fruits destined to the EU are noted in the EUROPHYT (2016) report of plant health, showing rejections on the basis of harmful organisms like citrus black spot (CBS) and what is termed other documentary reasons. The EU market is considered a CBS sensitive market.

EUROPHYT is the European Network of Plant Health Information Systems responsible for reporting on rejections of imports into the EU among other issues. In the years 2011 to 2016 a total of 216 rejections of consignments from South Africa to the EU concerning harmful organisms have been reported on EUROPHYT as noted from European Commission (2016). Put in perspective, if a total of five rejections are reported on EUROPHYT, the situation warrants a ban on importation by the EU for that specific year. South Africa has on more than one occasion experienced this situation of five or more rejections. Sinopoli and Purnhagen (2016) indicate that South Africa argues that CBS related prohibitions have no scientific justification except that the EU imposes this SPS measure to restrict trade.

Whilst all the information concerning a TRQ has to be notified at the World Trade Organisation (WTO), the TRQs still remain unfilled. WTO (2016) notes that as recent as 2013 and 2015, South Africa has raised concerns regarding the EU restrictive measures on CBS and that the CBS issue has been long standing since 1994. South Africa has in response, put systems of control in place which are periodically audited by the EU. The producing units/farms which are the sources of the fruits need to be registered and inspected. In South Africa, the Perishable Products Export Control Board (PPECB) is involved as an agent for DAFF in monitoring, certification for exporting and general export controls to the EU market. Some processing and exporting establishments in South Africa have raised concerns that the PPECB mandatory inspection processes duplicate their own processes and ultimately raise the fruit processors' costs. The PPECB in its annual report of 2012/13 indicates, for example, 16 811 rejections related to cold chain risk management of perishable products.

This study, whilst not quantifying the NTMs in their tariff equivalents, makes an assessment of the reduction of NTMs as explained in the scenarios presented in Section 4.6.3. Uncertainty surrounds the removal of some SPS measures that might have health implications. Removing an NTM can shift the export supply to an extent that equals an exporter's ability to comply with a given NTM. With this consideration in mind, this paper analyses the removal of NTMs in a GTAP CGE model as both a direct and an indirect shock to the supply curve.

2.3 Supply and demand situation of fruit products in South Africa and the EU

When climate and weather negatively influences production of fresh produce in the EU, opportunities exist for exporters of canned fruit from the geographical south, such as South Africa. Given the long shelf life of canned fruits, seasonal variation in supply is not an issue as the producers of canned fruit can store the products. CBI (2018) notes an increase in total European imports since 2012 at an average 1 per cent annual growth rate. There are no structural changes in the EU market that cause import fluctuations according to CBI (2018).

Kwasowski (2009) and European Commission (2011) indicate that the EU is a net importer of concentrated apple juice as well as processed pear products. Some studies (CBI, 2009; CBI, 2018) indicate an increase in total EU imports of canned fruit. CBI (2018) notes that import volumes are stable for canned fruit types that can also be found in Europe. Accordingly, EU demand for imports exists even though there is production of canned fruit in Europe. Tropical products import volumes have been on the increase according to the same report. Data on consumption of juices and canned fruit show an upward trend indicating that there is demand.

A frozen orange juice tariff line comparison of exports (in 2016) based on the TradeMap database of international trade statistics shows that South African exports to the EU, South African exports to the world and EU imports from the world were as follows – US$3737, US$4708 and US$459 546 respectively. This shows that there is enough potential demand in the EU if South Africa could be more competitive. The same picture is gleaned for the 2011 and 2012 trade values. An aggregation of TradeMap data shows that for the pears, apricots and peaches tariff lines (HS2008.40/50/70) in the years 2011, 2012 and 2016, South Africa exported to the EU only about 10 per cent of what the EU imports from the world in quantity terms. South Africa is able to export twice more to the world than its exports to the EU. In 2016, for example, South African exports to the EU and the world in quantity terms were 29 824 tons and 92 673 tons respectively (TradeMap, 2018). South Africa therefore clearly has some capacity to increase exports to the EU.

3. Literature

The focus of this brief review of literature is on relevant studies on TRQs and on NTMs in the context of agricultural trade mainly between African countries and the North. A few of the reviewed studies focus on trade between developed nations for comparison purposes. Some of the studies on NTMs are further elaborated below.

Khorana (2008) alludes to the existence of non-tariff barriers in explaining why TRQ utilisation is low concerning the market access for agricultural products. In addition Khorana (2008) rules out the lack of export potential in developing countries as a factor negatively affecting market access. Kareem (2011) in contrast to Khorana (2008), concludes that the inadequate production capacity besides the inadequate implementation of trade agreements explain why African countries have not taken advantage of the market access granted in the EU market. Technical and non-technical NTMs have been isolated and characterised in Beghin and Xiong (2016). On that basis, it suffices to describe the NTMs pursued under the TDCA and imposed by the EU on fruit products as protectionist in nature since the fruit products are classified as sensitive products of the EU28. The "sensitive product" classification by the EU is intended to justify the need to implement measures to protect domestic supply in the EU.

The EU being a big player in the world of fruit and vegetable imports, as noted in Cioffi *et al.* (2011) as well as in Santeramo and Cioffi (2012), the EU can also be expected to assume a dominating position in the provision of market access for South African fruit and fruit products into the EU. The objective to provide market access of fruit products through TRQs is explained in the context of the TDCA, that fruit products are sensitive products of the EU. Hence the EU justifies the motivation for the existing quota restriction coupled with the imposition of an in-quota and out-of-quota tariff rate. Matthews *et al.* (2017) indicate the prevalent use of TRQs by the EU as the way in which agricultural

trade is managed for the EU and further describe a phenomenon where country TRQs are unfilled due to quotas being allocated to countries unlikely to export certain products.

Nimenya *et al.* (2012) points to the fact that African countries have lagged in their export performance in the EU market noting stringent safety standards and NTMs impacting food exports. Kareem (2011) confirms the importance of the EU as a market for African exports in the same vein noting the presence of NTMs faced by African countries in their trade with the EU. In a study of NTBs faced by South African firms, Koch and Peet (2007) conclude that the difficulties faced by South African firms in exporting destinations have their basis in technical regulations for example conformity assessment and product certification.

Dal Bianco *et al.* (2015), Disdier *et al.* (2015) and Gebrehiwet *et al.* (2007) indicate that since the advent of the Uruguay Round Agreement on Agriculture there has been a trend to decrease tariffs. More stringent technical barriers have arisen to compensate for decreased tariffs as noted in these studies; the consequence being on the export of agricultural products from developing nations. Gebrehiwet *et al.* (2007) conclude that stringent sanitary and phytosanitary (SPS) standards set by the developed nations erode the perceived gains of liberalisation. With the increase in economic integration agreements Disdier *et al.* (2015) highlighted that it has become common practice to include protocols or provisions on NTMs. In this regard, the TDCA is no exception as provisions such as the rules of origin form part of the agreement.

A summary of existing literature on the analysis of TRQs and/or NTMs in different analysis frameworks, including a CGE framework, is presented in Table 4. A number of studies have analysed NTMs and TRQs from different perspectives and methodologies. Most of the studies listed in Table 4 are closely related to the methodology of analysing NTMs in a CGE framework, but differ in the approach to calculating the shock value of modelled NTMs. The results of reviewed studies presented in Table 4 also differ depending on the analysis and the commodities.

Among the authors, Arita *et al.* (2017) and Bureau *et al.* (2014) use the gravity model in establishing the *ad valorem equivalents* (AVEs) of NTMs and combine the analysis with NTMs removal in a GTAP CGE model. It is demonstrated in Dal Bianco *et al.* (2015), through a calculation of AVEs for technical barriers, that technical barriers being country specific have a prohibitive tendency. Transaction costs for exporters are raised. Studies on NTMs thus reveal that NTMs are a significant factor impacting export market access either positively or negatively depending on the target focus of the NTM.

Various studies (Gonzalez-Mellado *et al.*, 2010; Dal Bianco *et al.*, 2015; Arita *et al.*, 2017) have addressed the issues of NTMs using gravity models in combination with CGE analysis. Gonzalez-Mellado *et al.* (2010) characterise the specific NTMs restricting trade of various unrelated products between the EU and selected African countries from an exporter's view. NTMs are also analysed in a CGE model in this paper and in contrast to Gonzalez-Mellado *et al.* (2010) and other studies, the analysis focuses on South African fruit products TRQ exports and does not employ gravity analysis. Instead, this paper utilises exporter reported experiences/impressions on the intensity of the impact of NTMs and other influential factors as input to modelling the shock in the GTAP model. The weighted contribution of NTMs towards quota fill is calculated and implemented in the GTAP CGE model as elaborated in Section 4.

4. Methods

To get an insight into TRQ administration, NTMs and other influential TRQ fill factors, interviews included 16 exporting establishments, two representatives within South African Fruit and Vegetable Canners Association (SAFVCA) and South African Fruit Juice Association (SAFJA) umbrella associations in the fruit canning and fruit juice sectors, as well as eight key informants in government departments (interviewed between October 2016 to December 2017). The government officials were drawn from the Department of Trade and Industry and the Department of Agriculture, Forestry and Fisheries involved in the implementation of the trade agreement and the administration of TRQs respectively.

Table 4. Summary of literature on TRQs and/or NTMs analysis.

Study	Commodity focus	Approach to TRQ and/or NTMs analysis	Description of analysis framework	Key results
Arita *et al.* (2017)	Agricultural foods	Estimate AVEs of NTMs	Sector specific gravity model GTAP model	NTMs removal leads to trade expansion with higher gains when NTMs removal is coupled with tariffs removal. Tariff reduction results are ambiguous. In some agricultural sectors, net exports and production decrease. In many of the agricultural sectors tariff removal lead to gains which depends on the size of the tariffs.
Bureau *et al.* (2014)	Agricultural foods	AVEs of NTMs implemented either as a tax or as an efficiency loss	Gravity analysis and MIRAGE CGE model	25% reduction of NTMs increases trade by 60%. Gains from trade are very low with tariff removal.
Dal Bianco *et al.* (2015)	Wine	AVE using average import price wedge	Gravity analysis PPML model	SPS measures do not inhibit trade. Technical barriers cause substantial trade barriers to exports. A 1% increase in tariffs reduces trade by 0.47%
Gebrehiwet *et al.* (2007)	Food	Total aflatoxin level	Gravity model	Stringent SPS measures limit trade
Gonzalez-Mellado *et al.* (2010)	Agricultural and horticultural products	AVEs of NTMs	Gravity model and GTAP CGE model	Positive trade effect from removing trade barriers like standards and regulation, transport, packaging, handling and preserving. Removal of NTMs increase exports from African countries to the EU. Welfare results are mixed with some countries suffering welfare losses due to removal of NTMs. South Africa experiences welfare gains.
Kareem *et al.* (2018)	Tomatoes, oranges, limes, lemons	Index of protectionism	Gravity model and Probit model	Standards in the EU tomato sector are protectionist whilst there is no protectionism affecting exporter decisions to export oranges, limes and lemons to the EU.
Khorana (2008)	Various agricultural	AVEs	Descriptive	TRQ management is complicated, lacks transparency and results in high transaction costs.
Li and Carter (2009)	Various	TRQ fill rates	Tobit model	Reduction of in-quota tariffs significantly improves market access. Reduction of MFN tariffs marginally improves market access.
Lim and Blandford (2009)	Various	Tariff quota equivalency test	Static analysis	Quota administration methods significantly impact fill rates. Tariff reduction in full is preferable over smaller tariff reductions or increasing TRQs
Monnich (2003)	Various	TRQ fill rates	Censored regression model	Fill rate is determined by quota size and tariff. Results on quota administration methods' impact on fill rates are inconclusive.
Nimenya *et al.* (2012)	Fish	AVEs of European food standards using the price wedge method to quantify NTMs	Displacement multimarket model	A decrease in AVEs from an African source positively affects imports and negatively affects price

Source: Own compilation.

Secondly, the analysis of trade liberalisation scenarios of fruit products TRQs including the removal of NTMs is simulated in a GTAP CGE model which is solved in General Equilibrium Modelling Package (GEMPACK) software.

4.1 Survey design

4.1.1 Sample selection

As is typical in the nature of processed agricultural exports, only a few establishments have a comparative advantage as noted in Brooks (2018). The nature of the study dictates a sample selection focused on fruit juice and canned fruits, thus limiting the size to a total of 23 establishments recorded in the Food Trade SA Directory of 2016. The sample size representing the targeted export establishments was adequate for purposes of the information required to indicate the stringency of NTMs in a Likert Scale.

The directory lists four produce groups: citrus fruit, deciduous fruit, subtropical fruit and exotic fruit. In the first stage three groups relevant to the study are selected, namely citrus, deciduous and subtropical. Table 5 shows the structure of the sampling frame by produce groups and number of establishments in each group. Some of the establishments engage in overlapping activities across the fruit/fruit products export chain and a few of those establishments also engage in activities in more than one commodity group.

In the citrus produce group with 60 establishments, only eight engage in juice/puree exports. The deciduous produce group has five canned fruit exporters from the 55 establishments. In the sub-tropical produce group, of the 33 listed exporters, nine are involved in fruit juice exports and five in canned fruit exports. Four of the five canned exporters are also fruit juice exporters. Due to this overlap, a combined 10 fruit juice and canned fruit exporting establishments are in the sub-tropical produce group. Based on the information in Table 5, a total of 23 exporting establishments were presented with questionnaires. Sixteen questionnaires were returned making up 69.6 per cent of the target. Accordingly, the 16 respondents were selected based on their availability and willingness to participate.

4.1.2 Questionnaire

Exporting experiences about influential factors to the level of exports were the main subject of the probing questions in a structured questionnaire comprising 26 questions. Seventeen of the questions relate to NTMs. The questions are divided into four categories, namely: (A) TRQ administration methods, (B) TRQ definition and use conditions (C) Supply and demand conditions of export commodity as well as (D) tariff levels and associated trade arrangements.

Other general questions relating to the stakeholders' activities in the export market are also included in the questionnaire. The 26 questions in the four categories are shown in Table 6 presented in Section 4.1.3 for the calculation of intensity scores of each influential factor preventing quota fill.

4.1.3 Calculation of Likert scale values, intensity scores and the NTMs proportion in the influential factors to quota fill

A five-point Likert scale is used to rate exporter experiences concerning the intensity of influence of each aspect on the level of exports. The rating provides a realistic insight useful to discern the strength of each category of factors in affecting quota fill. The intensity score for each factor's influence on quota fill is calculated as the average/mean of the 16 Likert score responses for each influential factor. To determine each factor's weight in influencing quota fill, the calculated mean intensity score is divided by the sum of mean intensity scores obtained for the 26 influential aspects. To calculate the total contribution of NTMs in influencing quota fill, the sum of the weighted

Table 5. Sampling frame of establishments in different produce groups.

	Exporter/trader/agent		
Produce groups	Juice/puree/canned fruit	Other	Total
Citrus	8	52	60
Deciduous	5	50	55
Sub-tropical	10	23	33

Source: Author's compilation based on Food Trade SA Directory (2016).

Table 6. Observed influential factors and intensity scores in affecting quota fill.

NTM types, tariff factors and other influential aspect to TRQ fill assessed	Average Likert score value[a] ($n = 16$)	Influential factor weight (%)		Influential factor weight (%) in category	
		NTM	Other	NTM	Other
A. The following TRQ administration aspects influence the level of exports towards filling of fruit/fruit products quotas					
1. Implementation mechanisms not guaranteeing quota access	4	5.27		2.76	
2. Export licence allocation procedures for TRQs	2	2.49		1.30	
3. Costly and cumbersome administration procedures needing documentation	3	4.42		2.31	
4. Associated transaction costs, e.g. permit fees	3	4.21		2.20	
B. The following aspects of TRQ definition and use conditions influence the level of exports towards filling of fruit/fruit products quotas					
5. Size of TRQ notified	3	4.63		2.42	
6. Time validity of allocated quota	2	3.56		1.86	
7. Stringent safety standards and SPS measures	4	5.15		2.69	
8. Packaging and labelling requirements	3	4.42		2.31	
9. Definition of TRQ at broad HS level	1	2.10		1.10	
10. Narrow product definition	2	2.73		1.43	
11. Amount of quota applied for by all applicants imposing smaller individual allocations	5	7.11		3.72	
12. Condition of total number of applicants for quota posing competition	5	6.62		3.46	
C. The following TRQ supply and demand aspects influence the level of exports towards filling of fruit/fruit products quotas					
13. Inadequate supply	3		4.64		2.43
14. Low demand for imports	3		3.88		2.03
15. Unattractive market conditions in export markets	3		3.92		2.05
16. High freight charges	3	4.68		2.45	
17. High communication costs	2	2.65		1.38	
18. High transport costs	3	4.15		2.17	
19. Requirements on how products should be processed	3	4.42		2.31	1.77
20. Discrimination among exporters by importers	2		3.39		1.79
21. Indirect trade from developing countries through the EU	2		3.43		2.24
22. Distance between South Africa and EU market	3		4.29		
23. Rules of origin	3	4.78		2.50	
D. The following aspect of TRQ associated with tariff level conditions influence the level of exports towards filling of fruit/fruit products quotas					
24. Binding in-quota tariffs	2		3.06		1.60
25. Other trade arrangements offering better tariffs than TDCA in-quota tariffs	2		2.82		1.47
26. Competing TRQs with TDCA	3		3.92		2.05
Total	**73**	**68.75[b]**	**31.25**		

Source: Author's own investigations and calculations.
Notes:
[a] 1 = not at all; 2 = not very much; 3 = moderate; 4 = quite a bit; 5 = very much.
[b] The value is 63.92 when the SPS score is excluded.

averages for the 17 NTMs is taken. The results on the contribution of NTMs in influencing quota fill presented in Table 6 are included as an input in the GTAP model detailed in Sections 4.2 to 4.6.

In Table 6, columns 4 and 5 present the NTMs and non-NTMs factor weight of influence for each specific influential aspect to quota fill. The three tariff-related influences categorised in (D) contribute 9.8 per cent of the influences impacting quota fill. The measure of intensity by factor weight indicates that NTMs contribute a given total weight of 68.75 per cent. Excluding the SPS measure of 5.15 per cent, the NTMs weight is about 64 per cent. The remaining 31 per cent is accounted for by other influential factors such as supply and demand as well as tariff-related influences. Individually the NTMs contributing higher weights are within the TRQ administration mechanisms and TRQ use conditions.

The intensity score measuring the influence on quota fill is developed as an alternative to the AVE measure and in departure from the studies reviewed and presented in Table 4 in Section 3. The NTMs

removal/reduction is implemented in a GTAP CGE model as a counterfactual simulation where the trade cost reducing variable "*ams*" is shocked by the calculated value of contribution of NTMs in the influential factors to quota fill. Further details on NTMs removal are presented in the policy case scenarios in Section 4.6.3.

4.2 Sector aggregation in the GTAP model

The GTAP database version 9 is well documented in Narayanan *et al.* (2015) and in Aguiar (2016). GTAP database version 9 is the current version with base year 2011. The basic GTAP model is a static general equilibrium model with no time dimension (Plummer *et al.*, 2010). This is as opposed to dynamic models that analyse lagged transmissions and adjustment processes over time. For a static CGE model, when simulating impacts in the future, the time path followed in the period of intervention is not a subject of analysis. In order to simulate policy outcomes in this regard, what is needed are the exogenous inputs for the expected conditions in the year of interest (Burfisher, 2011; Burrell *et al.*, 2011).

The target sector in this study is the food products sector referring to the food products not specified elsewhere in the other 57 GTAP sectors. The food products sector is abbreviated "OFD" and is number 25 of the 57 GTAP sectors in the GTAP model. The paper makes an extension that introduces fruit TRQ products to the GTAP database. The extension is focused on the trade flows of canned fruits (HS2008) and fruit juice (HS2009) tariff lines. All the other information in the database is preserved and thus not altered. The GTAP OFD sector comprises 262 HS6-digit tariff lines. Splitting the OFD sector enables the introduction of fruit TRQ products as sectors in the model. The TDCA canned fruit and fruit juice TRQs are made up of various HS6-digit tariff lines. In this regard, five TRQs comprising a total of 10 HS6-digit tariff lines are split from the OFD sector. The five TRQs are thus represented as five new GTAP sectors.

Splitting weights are generated for the TRQ products based on the Tariff Analytical and Simulation Tool for Economists (TASTE) developed by Horridge and Laborde (2010). TASTE contains a database of bilateral trade flows based on MAcMapHS6 data which is consistent with GTAP data. Thus, the splitting weights generated are based on actual trade flow weights sourced from this publicly available data. The trade flow based weights are then used in SplitCom (a GTAP utility developed by Horridge, 2008) to split the GTAP OFD sector. A table of the splitting weights used is presented as Appendix 1. The output shares and consumption shares were not modified for this paper and thus the proportions in the GTAP OFD sector are assumed and preserved in the creation of the new GTAP sectors.

The disaggregation into HS 6-digit tariff lines, defines the sub-sectors targeted in this study which are:

(1) HS0811.10 – frozen strawberries,
(2) HS2008.40 – canned pears, HS2008.50 – apricots and HS2008.70 – peaches,
(3) HS2008.97 – canned mixtures of fruit,
(4) HS2009.11 – frozen orange juice,
(5) HS2009.41/49 – pineapple and HS2009.71/79 – apple juice.

The remainder of the other tariff lines from the OFD sector are aggregated and reassigned into an "other-OFD" sector. Such disaggregation is chosen in order to enable the analysis of the six fruit products TRQs of the TDCA. As indicated in Section 2.1, two TRQs, the canned fruit mixtures (tropical and non-tropical) have been combined into one TRQ. The combined TRQ is coded "FRUITMIX". Table 7 shows the aggregation scheme of the sectors, summarises the GTAP sectors mapped and the tariff lines aggregation of the TRQ commodities. The rest of the GTAP sectors are aggregated into "other-agriculture", "non-agriculture" and "services" making up a total of nine sectors in the model.

4.3 Tariff rates aggregation at the TRQ level

An aggregation of HS 8-digit tariff lines to the HS 6-digit level TRQs has been conducted in order to transform the tariff rates implemented in the model simulations. To aggregate tariff rates from the

Table 7. Mappings of GTAP sectors modelled.

GTAP sectors (57) description	Sectors modelled (9)		Aggregated mapping of the fruit TRQ sector in model
	Abbreviation in model	Description	
Processed fruit products	FROZJUCE	Frozen orange juice	TRQCOM
	PAP	Canned pears, apricots and peaches	
	STRAWBRY	Frozen strawberries	
	APLEPINE	Apple, pineapple juice	
	FRUITMIX	Canned fruit mixtures	
Processed food products (ofd) excluding tariff lines HS2009.11; HS2008.40/.50/.70; HS0811.10; HS2009.41/.49/.71/.79 and HS2008.97	OTHEROFD	Other processed food products	OTHEROFD
Paddy rice, wheat, cereal grains nec, vegetables/fruit/nuts, oil seeds, sugar cane/sugar beet, plant-based fibres, crops nec, cattle/sheep/goats/horses, animal products nec, raw milk, wool/silkworm cocoons, forestry, fishing, meat: cattle/sheep/goats/horse, meat products nec, vegetable oils and fats, dairy products, processed rice, sugar, beverages and tobacco products	OTHER_AGRIC	Other agriculture	OTHER_AGRIC
Coal, oil, gas, minerals nec, textiles, wearing apparel, leather products, wood products, paper products, publishing, petroleum/coal products, chemical/rubber/plastic prods, mineral products nec, ferrous metals, metals nec, metal products, motor vehicles and parts, transport equipment nec, electronic equipment, machinery and equipment nec, manufactures nec	NON_AGRIC	Non-agriculture	NON_AGRIC
Electricity, gas manufacture/distribution, water, construction, trade, transport nec, sea transport, air transport, communication, financial services nec, insurance, business services nec, recreation and other services, pub/admin/defence/health/Education, dwellings	SERVICES	Services	SERVICES

Source: Own aggregation based on GTAP version 9.

tariff line level to a TRQ level, the median tariff rate is used as suggested in Dal Bianco *et al.* (2015). Within each TRQ, exports are made at any of the HS 8-digit tariff lines in any combination to fill the TRQ, hence a simple median of the tariff rates is utilised. The aggregated in-quota and out of quota tariffs for fruit TRQ imports by the EU from South Africa and the rest of the world (ROW) are presented in Table 8.

The tariff rate that applies in the model is the in-quota tariff rate. There are no out of quota exports that attract the out-of-quota tariff rates since the quotas in the model are unfilled. Based on the TDCA tariffs, the most protected sector is the apple, pineapple juice sector followed by the canned pears, apricots and peaches sector.

4.4 The model calibration and data sources

The existing tariff rates in the GTAP database are calibrated to the TDCA fruit products tariff levels (Table 8), creating a base case for the analysis. The GTAP database version 9 is the source of data for the 2011 base year. Tariff data on TDCA fruit TRQs for 2011 to 2016 is sourced from the Tariff Integre Communautaire/Integrated Tariff of the European Communities (TARIC) database of 2018. The traded value of exports in the GTAP CGE model is adopted at the TRQ utilisation levels. An adjustment to account for quota fill and the presence of NTMs in respective scenarios is undertaken through counterfactual simulations as described in Section 4.6.

Table 8. TDCA tariff rates (%) imposed by the EU on South African exports.

	TDCA tariff (2011–2016)	
Fruit TRQ	In-quota	MFN (out-of-quota)
Frozen orange juice	7.9	15.2
Canned pears, apricots and peaches	9.29	17.8
Frozen strawberries	0.0	14.4
Apple, pineapple juice	9.98	22.24
Canned fruit mixtures	8.95	17.2

Source: Own aggregation based on TARIC database

4.5 Equations targeted in the GTAP model

The following linearised Equations (1) to (3) in the GTAP model are the basis upon which the results of the simulations are discussed. The variables signify percentage changes of the quantity levels.

$$qxs_{i,r,s} = -ams_{i,r,s} + qim_{i,s} - ESUBM_i * [pms_{i,r,s} - ams_{i,r,s} - pim_{i,s}] \quad (1)$$

$$pms_{i,r,s} = tm_{i,s} + tms_{i,r,s} + pcif_{i,r,s} \quad (2)$$

$$pim_{i,s} = \sum_k (MSHRS_{i,k,s} * [pms_{i,k,s} - ams_{i,k,s}]) \quad (3)$$

In the same convention of the GTAP model, *i* represents the sector. The source country, *r* is South Africa and the destination country, *s* is the EU. The demand for imported commodities disaggregated at sector level is $qxs_{i,r,s}$ which depends on *ams*, a technical change variable; *qim*, quantity of imports of commodity *i* imported by region *s*; *pms*, market price of commodity from *r* to *s*; and *pim*, market price of aggregate imports of commodity *i* in region *s*; *tm*, power of the import tariff on all imports of *i* by *s*; *tms,* power of tax (1 plus *ad valorem* tariff) on imports of *i* from *r; pcif*, world cif price of *i* imported from *r*; ESUBM is the elasticity of substitution of imports among different sources and MSHRS is the share of imports from different regions, *k* in import bill *of s*.

4.6 The model simulation design and policy case scenarios

Five sub-sectors of the GTAP food products sector are isolated for analysis (Table 6) and coded – frozen strawberries (STRAWBRY), pears, apricots and peaches (PAP), fruit mixtures (FRUITMIX), frozen orange juice (FROZJUC), apple and pineapple juice (APLEPINE). Three regions are distinguished in the model, namely South Africa, EU28 and the Rest of the World (ROW).

4.6.1 Adjustments to base data tariffs

To adjust the base data tariff rates to the TDCA tariff levels, a shock to the variable "*tms*" (power of tax on imports) is implemented. In implementing the shock, a modelling convention in GTAP of using an "altertax closure" is followed. The altertax simulation preserves the shares in the model to ensure that the trade flows remain balanced after a tax shock. The specific tax rate shock to each TRQ is indicated in Appendix 2. A new equilibrium is established and the new database generated is used in carrying out the subsequent liberalisation simulations. The other shocks to the model and relevant closures adopted for the different experiments are also illustrated in Appendix 2.

4.6.2 Calculation of the TRQ fill coefficient

NTMs are quantified as a part component of the identified influential factors preventing quota fill. The shocks to each TRQ needed to bring a 100 per cent fill rate is a calculated fill coefficient, α^{-1}. In calculating the TRQ fill coefficient, the full component of influential factors to quota fill is calculated to be a coefficient equal to the proportion of the unfilled quota. A proportion α represents the

proportion of the exported quantities in relation to the notified available quota level. The proportion 1 − α is the component of unfilled TRQ that can be accounted for by the presence of influential factors to quota fill including NTMs. The new variable added by this paper in the database is *fqxs*, which is the filled quota in equation (4) and α^{-1} the fill parameter that brings the original GTAP variable *qxs* to TRQ fill level *fqxs*.

$$fqxs_{i,r,s} = \alpha^{-1}\{-ams_{i,r,s} + qim_{i,s} - ESUBM_i * [pms_{i,r,s} - ams_{i,r,s} - pim_{i,s}]\} \quad (4)$$

The shock to *qxs* shifts the under-filled TRQ trade flows to new levels thus generating flows that fill each of the shocked TRQs.

4.6.3 Policy case scenarios and experiments

The base case scenario is the scenario in which TDCA tariffs have been implemented and is the basis for the policy case scenarios that follow. The scenarios are labelled policy case (PC) 1 up to 4.

1. *PC1: Export expansion.* An expansion of 3 per cent is intended to mirror a realistic scenario of the TDCA. The TDCA provision to expand quotas by 3 per cent assumes that exports would expand at that same rate of 3 per cent annually. However, actual fruit products exports for each of the TRQs either increase or decrease at different annual growth rates to the blanket 3 per cent annual expansion provided for in the TDCA. In view of this, two different export expansion scenarios are detailed below as *PC1(a)* and *PC1(b)*.
   (a) The TDCA provides for annual expansion of the quota by a growth factor of 3 per cent. Given that TRQs are not filled, this scenario is implemented as an export expansion, which assumes the maximum allowable exports if the actual exports were to equally respond. As in Gilbert *et al.* (2018) the equivalent of a shock to the power of the tariff rate (*tms*) that would cause a 3 per cent increase in exports is implemented. This simulation assumes that South African exporters would have expanded their within quota exports by the same amount of 3 per cent provided for in the trade agreement resulting in TRQ export levels of 2012. This shock does not expand exports to the full available quota level because in the 2011 database the actual trade flows presented are not the full quota level.
   (b) The 3 per cent TDCA provision increases the potential market access for South Africa but that increase is not translated into actual exports at that same rate. In this scenario the TRQ is expanded using the rate at which actual TRQ exports have grown from 2011 to 2012. The variable "*qxs*" which is the quantity of exports, is exogenously shocked. The specific shock values to each TRQ are shown in Appendix 2, showing a decrease for all TRQs except the frozen orange juice TRQ. The shock on exports in this scenario enables the comparison of the results of the rate of growth of actual exports to the 3 per cent annual growth factor.
2. *PC2: In-quota tariff removal of 100 per cent.* A complete tariff liberalisation of the base tariff rates indicated in Table 7. This scenario is a reality to be phased in as one of the outcomes of the SADC-EU-EPA negotiated concessions for some TRQs. The power of the tariff (*tms*) is shocked to bring the target rate to 0 per cent. The intention is to establish the impacts if such a liberalisation occurred earlier in 2011 for all TRQs except frozen strawberries already with a 0 per cent in-quota tariff rate.
3. *PC3: Removal/reduction of influential factors to quota fill.* This scenario is in two parts and excludes the frozen strawberries TRQ for which no trade occurs.
   (a) Quota fill to 100 per cent due to the removal of influential factors to TRQ fill including NTMs is simulated in this part. There are several enablers that make this simulation plausible: (1) existence of demand in the EU, (2) already low tariffs and (3) adequate supply capacity by South Africa. These have been elaborated in Sections 2.1 and 2.3. The filling of quotas is within the exporter's devices because South African exporters have adequate capacity in this sector added to the knowledge that tariffs are already lowered under the TDCA provisions. The

remaining impediment to filling the quota is the NTMs and other influential TRQ fill factors in place.

(b) As proposed by Beghin and Xiong (2016), that trade costs like NTMs explain trade flows, this study tests that proposition in the GTAP model by shocking the exports variable *qxs* (quantity of exports). The basis for shocking *qxs* to quota fill level (using the parameter elaborated in Section 4.6.2) is that when the impediments influencing the level of exports are removed, the quota fill level is reached (Equation (4)). The unfilled component of the quota is exogenous in this analysis. There are sensitivities in removing some NTM like SPS measures but such sensitivities are not considered in this scenario.

(c) Partial NTMs removal. Part of the missing TRQ trade is due to NTMs. The unrealised export value is a trade cost. The trade cost is a proxy for the NTMs and other influential factors preventing quota fill. The technical change variable "*ams*" in Equation (1) is shocked by 64 per cent, which is the value of the weight of intensity of influence of NTMs on quota fill. The basis for this calculated weight is explained and presented in Table 6 in Section 4.1.3.

(d) The weight of all NTMs' contribution is 68.75 per cent. The SPS measures' contribution of 5.15 per cent is excluded in the value of the shock of 64 per cent. This is in line with Kierzenkowski *et al.* (2018) noting that trade costs related to NTMs like SPS measures will always be incurred and cannot be completely removed like tariffs. The shock to "*ams*" is intended to improve quota fill by removing the trade costs due to the presence of NTMs. NTMs are considered as a barrier to quota fill, hence NTMs of all forms except the portion attributed to SPS measures are removed.

4. *PC4: Quota fill and 100 per cent tariff liberalisation*.

(a) In this scenario, a combination of *PC3(a)* and *PC2* is implemented. After the removal of influential factors to quota fill introduced as a shock to the variable *qxs* which brings the TRQ to 100 per cent fill, the updated database is employed in the 100 per cent tariff liberalisation scenario. The export demand "*qxs*", is thus endogenously determined.

(b) NTMs removal combined with a 100 per cent tariff liberalisation. This is a combination of *PC2* and *PC3(b)* implemented simultaneously.

5. Results

5.1 Changes in production, consumption, exports and prices

Graphical illustrations are provided in Figures 1 to 3 to show changes in production, consumption, exports and prices after policy case scenario experiments *PC1* and *PC2*. The changes are compared with the baseline scenario in 2011. Price changes are explained via the mechanisms described in Equations (1) to (3) (Section 4.5). The existing TDCA tariff rates in the model range from 0 to 9.98 per cent and the shocks sizes implemented for a 100 per cent tariff liberalisation range between −7.3 to −9.0%, whereas the export expansion shock in PC1*(a)* is 3 per cent. The liberalisation policies are thus compared on the basis of realistic concessions that have been made or proposed for some of the fruit products.

In Figure 1, an export expansion of 3 per cent (*PC1(a)*) results in a negative change for all variables for all TRQs except industry output in South Africa, which increases for all TRQs. Notably the change for household demand in South Africa is very small to the extent of almost no change at all. At most, this result indicates the direction of the change which is a decrease in household commodity demand. Such a finding is explained through the analysis of the commodity price change which is recorded as an increase in South Africa in response to increased exports to the EU. Therefore household commodity demand decreases in response to induced price increases in South Africa as more of the TRQ product is destined to EU exports and subsequently competing with domestic demand in South Africa.

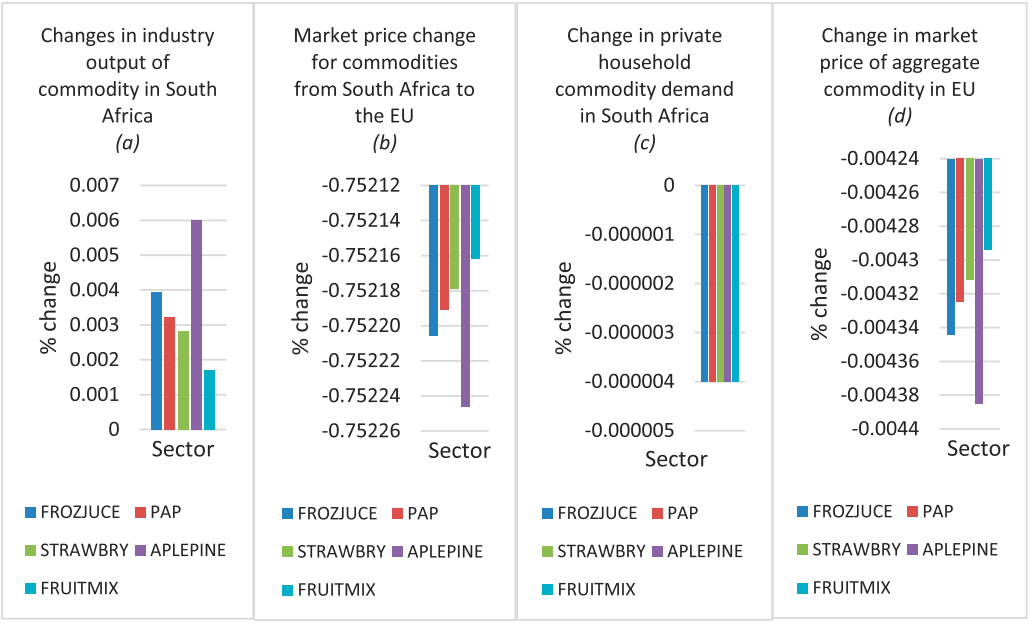

Figure 1. Percentage changes in industry output, market prices and consumption due to a 3 per cent quota level expansion (*PC1 (a)*). Source: Author's computation based on GTAP simulations.

The results from *PC1(b)* in Figure 2 give a comparison showing the missed opportunity when exports in *PC1(a)* are expanded by 3 per cent instead of expansion by the rate of actual export growth. Household demand in South Africa increases for all TRQs. Only frozen orange juice output in South Africa increases coupled with a market price decrease of South African products in the EU. The opposite is true for all other TRQs. An output decrease in South Africa is associated with increases in market price changes.

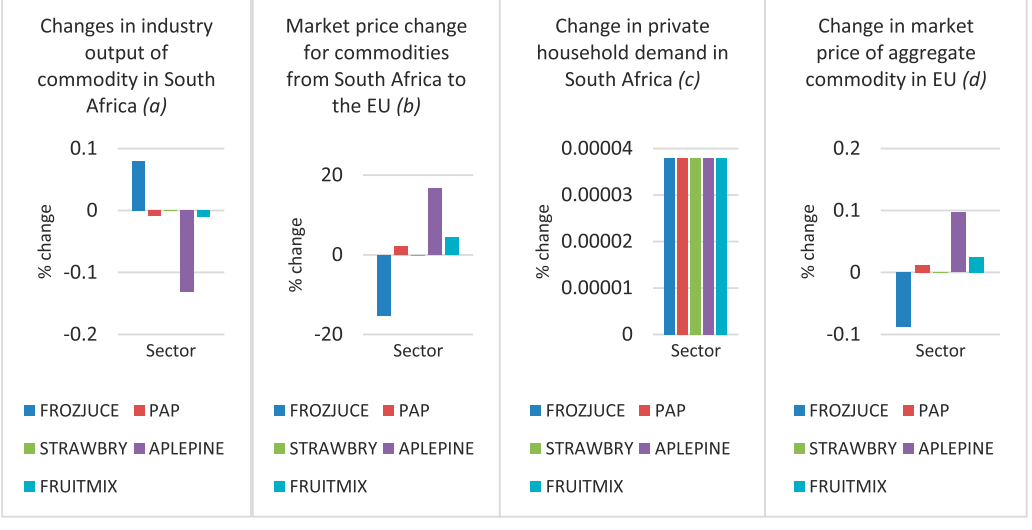

Figure 2. Percentage changes in industry output, market prices and consumption due to expansion by the actual recorded rate of increase in exports (*PC1(b)*). Source: Author's computation based on GTAP simulations.

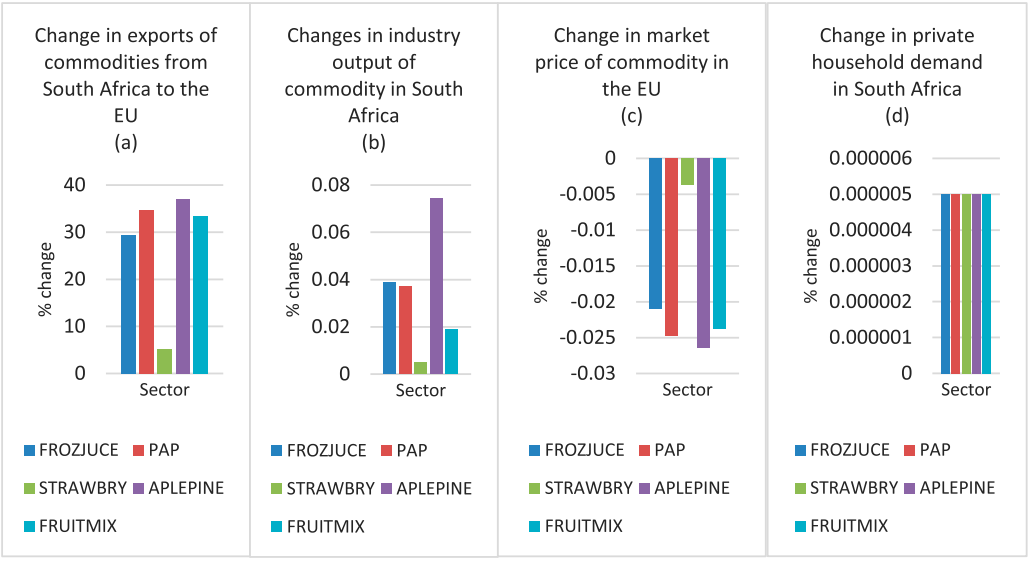

Figure 3. Percentage changes in industry exports, output, market prices and consumption due a 100 per cent tariff liberalisation (*PC(2)*). Source: Author's computation based in GTAP simulations.

The positive response in industry output for frozen orange juice supports the notion that, the 3 per cent annual TDCA provision to increase the quota acts as a stimulus for the exporter. The results confirm that a simulated export expansion of the expected TDCA quota expansion provision induces an increase in output in South Africa even when the quota is under-filled. The under-fill reasons from exporter experience findings (Table 6, Section 4.1.3) do not weigh heavily on capacity constraints related to supply as much as on aspects within the categories of TRQ administration, definition and use conditions. The 3 per cent quota expansion closes the market access gap and producers increase their output given the certainty of the annual quota increase which signals demand by the EU. The prices for output in South Africa are unchanged.

The result for the frozen orange juice sector is expected given that it is the only sector in which the actual exports have increased as described in *PC1(b)* in Section 4.6. There is a decrease in output in PAP, APLEPINE and FRUITMIX sectors as there is a shift to the more productive sector of frozen orange juice. In relative terms therefore, the demand for labour and capital increases more in the frozen orange juice sector (0.04%) than in other sectors. The frozen orange juice sector, however, receives a very small quota under the TDCA. The frozen orange juice sector had previously not been filled in 2010/11. Observations indicate that in subsequent quota periods (Table 3), the frozen orange juice TRQ has absorbed the improved market access opened up annually through the provision of a 3 per cent quota expansion.

The scenario *PC1(b)* thus gives insight into the consequences of the inability to fill quotas because, if quotas had been filled the expectation is that the exports will also increase by 3 per cent. The implication for policy is that market access provision of a 3 per cent quota expansion does not respond to the actual situation in South Africa concerning the unfilled TRQs. A different and more beneficial liberalisation policy is required as opposed to the blanket 3 per cent annual expansion for all TRQs.

The TDCA tariffs in the base year are at 50 per cent of the MFN rate except for the frozen strawberries TRQ which enjoys a 0 per cent in-quota tariff. A 100 per cent tariff liberalisation (*PC2*) results in the demand for exports rising about ±30 per cent for all TRQs except frozen strawberries (Figure 3). This is comparable to Li and Carter (2009) finding that the reduction of in-quota tariffs significantly improves market access. The change in industry output is less than 0.1 per cent for all the fruit products however this change is more than 10 times greater than under the quota expansion scenario

(PC1). These findings concur with Lim and Blandford (2009) concluding that full tariff liberalisation is preferable over smaller tariff reductions or increasing of TRQs. In addition, Figure 3 shows that the changes in exports are far beyond the size of the changes in industry output. This indicates that there is a shift from South Africa's other export destinations towards the EU market, utilising already existing industry level capacity. The increase in industry output, as expected, is much lower than the increase in exports given that the share of each of the fruit products export sales from South Africa to the EU is less than 0.1 per cent.

South African exports contribute less than 0.1 per cent of the EU's import bill hence the price changes due to trade liberalisation is also small. Exports are explained by the export expansion and imports substitution effects in Equation (1). The increase in demand from the EU is relatively small; for example, in the frozen orange juice sector *qim* (the export expansion effect) is 0.04 per cent. The average market price of imports in the EU (*pim*) falls but not as much as the related fall in the price of imports by the EU from South Africa (*pms*). The market price of frozen orange juice from South Africa to the EU, for example in *PC1(a)*, has fallen by more than 7 per cent in relation to the average price of imports into the EU. The effects of the fall in the price of South African products have negligible to no impact on the average price of imports by the EU since South Africa's share in aggregate imports of the EU is small. South African products compete with other countries' exports whose combined share is much greater than South Africa's share. The larger component of the increase in imports by the EU arises from the substitution term comprising the elasticity of substitution (ESUBM) and the price difference (*pms* – *pim*) in Equation (1).

These findings of the fall in prices of commodities due to trade liberalisation are also supported in Arita *et al.* (2017), indicating that the EU prices for agricultural commodities also decrease in a study when the EU removes tariffs on imports from the United States (USA). In addition as indicated in the results in this study presented in Figure 3, Arita *et al.* (2017) also find that price decreases result due to increased EU imports of US commodities when the EU removes tariffs. The decomposition of price mechanisms in EU tariff liberalisation scenarios show the same pattern for the USA and South Africa though the two regions may have different trade structures.

5.2 Change in welfare

The equivalent variation (EV) measure is used in analysing welfare. Using the prices before a policy change, equivalent variation is the amount of income that changes utility by the same amount as the policy. In the context of the trade liberalisation under the TDCA, EV calculates the income change that would make a country equivalent to what they would be after price changes resulting from a policy change (Arora, 2013). The fruit products export trade is a small sector in the model compared with other sectors (other-food products, other-agriculture, non-agriculture and services). The share of industry GDP is less than 2 per cent for the processed food products sector in which the fruit products belong. The welfare changes in Table 9 measured in EV are, therefore, not very large in the US$ Mil values (−US$0.006 Mil to US$0.232 Mil). The frozen orange juice sector, for example, has a share of 0.01 in industry GDP of South Africa. Similarly the labour share of the processed food products sector is approximately 3 per cent.

The results of the EV changes in Table 9 are decomposed into effects of allocative efficiency, technology, terms of trade (TOT) and investment savings. Endowment effects have a zero value for all scenarios and are not included in the table. Allocative efficiency losses arise for South Africa in all scenarios except *PC1(b)*. Allocative efficiency losses are the losses resulting from the reallocation of resources from more productive to less productive sectors. However, due to dominant TOT effects the total welfare results are positive for South Africa in all scenarios except in *PC1(a)* and *PC3(a)* which involve the expansion of exports. Improvements in TOT effects are experienced for South Africa in *PC1(b)*, *PC2*, *PC3(b)* as well as *PC4(a)* and *(b)*. TOT effects reflect the change in prices of South African fruit products exports to the change in prices of imports; as theoretically expected in these scenarios exports from South Africa to the EU become cheaper. The TOT effects dominate

Table 9. Equivalent variation results for different simulations (US$ mil).

Policy case (PC) scenario	Region in the model	Welfare decomposition – effects: Allocative efficiency	Technology	Terms of trade	Investment savings	Total welfare (US $ mil)
PC1(a)	South Africa	–0.001115	0	–0.02071	–0.00131	–0.02314
Export expansion of 3%	EU 28	0.00426	0	0.021575	0.000836	0.026671
	Rest of World	0.000074	0	–0.00086	0.000474	–0.00046
	Total	***0.003071***	***0***	***0***	***0***	***0.003071***
PC1(b)	South Africa	0.011177	0	0.207672	0.013127	0.231975
Export expansion by actual	EU 28	–0.047287	0	–0.21615	–0.008379	–0.271811
growth rate of exports	Rest of World	0.000744	0	0.008473	–0.004748	0.004469
	Total	***–0.035367***	***0***	***0***	***0***	***–0.035367***
PC2	South Africa	–0.00012	0	0.030426	0.001628	0.031943
100% tariff liberalisation	EU 28	0.023518	0	–0.02589	–0.00089	–0.00326
	Rest of World	–0.00122	0	–0.00455	–0.00074	–0.00650
	Total	***0.022179***	***0***	***0***	***0***	***0.022179***
PC3(a)	South Africa	–0.00068	0	–0.01257	–0.00079	–0.01404
Expansion to quota fill	EU 28	0.002675	0	0.013087	0.000507	0.016268
	Rest of World	–0.000045	0	–0.00052	0.000287	–0.00028
	Total	***0.001954***	***0***	***0***	***0***	***0.001954***
PC3(b)	South Africa	–0.0007	0	0.180917	0.009675	0.189891
NTMs removal	EU 28	0.157282	0	–0.14797	–0.004971	0.505006
	Rest of World	–0.00297	0	–0.03295	–0.004704	–0.040623
	Total	***0.15361***	***0***	***0***	***0***	***0.654275***
PC4(a)	South Africa	–0.00013	0	0.031943	0.001708	0.033525
Quota fill and 100% tariff	EU 28	0.023138	0	–0.02719	–0.00094	–0.00499
liberalisation	Rest of World	–0.00129	0	–0.00475	–0.00077	–0.00682
	Total	***0.021719***	***0***	***0***	***0***	***0.021719***
PC4(b)	South Africa	–0.00082	0	0.211353	0.011302	0.221834
NTMs removal and 100% tariff	EU 28	0.180801	0.500664	–0.17386	–0.005862	0.501743
liberalisation	Rest of World	–0.00419	0	–0.03749	–0.005441	–0.047124
	Total	***0.175789***	***0.500664***	***0***	***0***	***0.676453***

Source: Own simulation results in GTAP 9.

the negative allocative efficiency losses, resulting in a positive total welfare in South Africa. Negative TOT effects are of relatively dominant magnitudes to other effects contributing to total welfare in the implemented scenarios *PC1(a)* and *PC3(a)* which target export expansion only. When TRQs in the model are brought to the quota fill level in *PC3(a)*, such a scenario makes South Africa worse off by US$14 040 as resources are re-allocated from the non-TRQ sectors to the fruit products sectors to boost export production in addition to the negative TOT effects.

The expansion of the quota exports to full capacity (*PC3a*) does not improve the welfare situation in South Africa but improves welfare for the EU (US$16 268). The negative welfare (−US$14 040) that would result in this scenario explains why the quotas are unfilled under the existing trade conditions. Allocative efficiency losses in South Africa amount to US$680 as the reallocation of resources to less productive sectors ensues. The increase in demand for the factors of production in all TRQ sectors, ranging from 0.01 to 0.04 per cent, signals the reallocation of resources from non-TRQ sectors.

Whilst a 100 per cent TRQ fill leads to a loss in welfare of US$14 040 in *PC3(a)*, this loss is not as much as the loss of US$23 140 resulting from the 3 per cent annual quota expansion in experiment *PC1(a)*. The 3 per cent quota expansion is a provision of the TDCA. Scenario *PC4(b)* which combines full tariff liberalisation with the reduction of NTMs indicates that the provisions of the TDCA would be more beneficial (US$221 834) if measures to reduce or eliminate NTMs in combination with tariff removal are the focal point of South African trade negotiators rather than only the reduction or removal of tariffs. These finding are similar to Arita *et al.* (2017) showing that in many agricultural sectors the removal of NTMs lead to higher gains when NTMs removal is coupled with tariff removal.

The welfare results are also indicative of why EU negotiators favour to only fully liberalise tariffs in *PC2*. In scenario *PC2*, the EU experiences the smallest of the welfare losses compared with *PC1(b)* and *PC4(b)*. South Africa in scenario *PC2* makes a welfare gain of US$31 943, though smaller than the

welfare gain of US$189 891) in *PC3(b)* with NTMs removal only. Scenario *PC3(b)* amongst all scenarios, experiences the least negative allocative efficiency losses and the greatest TOT effects for South Africa. This scenario justifies a motivation for South Africa to have a bilateral agreement as the TDCA; however, trade negotiation efforts should focus on concessions for NTMs removal in addition to complete tariff removal, given the relatively higher positive welfare results in *PC4(b)*.

6. Conclusions and recommendations

The model results show that full TDCA tariff liberalisation induces substantial changes in exports (±30 per cent) but only small percentage changes in output. This inference is strengthened and is corroborated by the survey findings, in that TDCA tariffs on fruit products are already low and exert little intensity (3.06 per cent) in contributing to preventing quota fill or increased exports. Whilst there is a demand for making scholarly judgements on the effects of tariffs, the issue of NTMs that are working in tandem provokes the debate on the effectiveness of trade agreements. The NTMs are a trade cost found to account for 68.75 per cent of the influences that prevent quota fill. SPS measures contribute 5.15 per cent in that NTMs contribution. However, not all influential factors preventing quota fill are attributable to the importer. It is shown in this study that a portion of the NTMs with high factor weights in preventing quota fill is specific to the aspects of TRQ administration methods imposed by the exporter. An improvement in the TRQ administration system in South Africa is thus necessary.

The findings imply that about 64 per cent of the trade gap due to NTMs is closed in a scenario modelled to reduce NTMs (excluding SPS measures). This inference is made in view of the fact that all exported quantities as a result of the NTMs removal scenario (*PC3b*) exceed the quota fill level simulated in *PC3(a)*. The advocacy for TRQs removal and hence the associated NTMs removal is supported by such results which show that exports rise with the removal of NTMs. On the other hand, welfare analysis results show that there is a welfare loss (−US$14 040) when TRQs are expanded to full quota export flows in the model and this welfare loss also explains why quotas are not filled. A reduction of NTMs brings positive welfare results (US$189 891) which further improves welfare to US $221 834 when NTMs reduction is combined with full tariff liberalisation. The removal/reduction of NTMs induces quota fill and improves market access and the welfare gain to South Africa is higher after combining NTMs removal with a complete tariff liberalisation. Therefore, partial liberalisation, involving only removing the tariff, weakens the potential market access availed in trade agreements.

The ineffectiveness of TRQs as policy instruments in trade agreements is brought to the fore and this research effort has established that there are no feedback mechanisms that inform the annual quota expansion provision of the TDCA. The rate is arbitrary leading to implementing estimates far removed from the situation of actual export flows. Based on these findings, the recommendation from this study to negotiators of the trade agreement is that, mechanisms be put in place to allow for the flexibility in the annual growth factor based on annual trade flows. Inefficiencies in the quota administration system cannot be ruled out in explaining unfilled TRQs. Although the fruit products export sector may not be as productive as other sectors in the South African economy as may be suggested in welfare results on export expansion scenarios which indicate dominant allocative efficiency losses, the study does not rule out the impact of NTMs associated with TRQs.

The assertions that TRQs are compounding market access barrier problems are plausible and by their existence the TRQs are associated with other NTMs. The findings in this study contribute to the literature (Gonzalez-Mellado *et al*., 2010; Bureau *et al*., 2014; Beghin and Xiong, 2016) that shows that the removal of NTMs may reduce costs to exporters and ultimately expand trade. Full tariff liberalisation as presented in the findings of this study, increases exports but does not increase output. The welfare gains of a full tariff liberalisation are less than the welfare gains of NTMs removal which are also less than the welfare gains from a combination of full tariff liberalisation and NTMs removal. Therefore, the trade liberalisation process of fruit products TRQs should simultaneously implement full tariff liberalisation with TRQ expansion and the reduction of NTMs.

The results of this study strengthen a recommendation that other support policies are needed, especially focusing on increasing the number of participants in fruit products TRQ exports. Policies of this nature should simultaneously be implemented with tariff removal, NTMs removal and quota expansion in order to further boost export production.

Acknowledgements

The authors thank the Editor and the anonymous referees for their valuable comments and input which greatly improved this paper. This work is based on the research supported in part by the National Research Foundation of South Africa (Grant Number 110939).

References

Aguiar, A., Narayanan, B. and McDougall, R. 2016. An overview of the GTAP 9 data base. *Journal of Global Economic Analysis* 1(1): 181–208.

Arita, S., Beckman, J. and Mitchell, L. 2017. Reducing transatlantic barriers on US–EU Agri-food trade: What are the possible gains? *Food Policy* 68(1): 233–247.

Arora, V. 2013. *Alternative measures of welfare in macroeconomic models*. Independent Statistics and Analysis Working Paper Series. US Energy Information Administration, Washington, DC.

Barichello, R.R. 2000. A review of tariff rate quota administration in Canadian agriculture. *Agricultural and Resource Economics Review* 29(1): 103–114.

Beghin, J. and Xiong, B. 2016. *Economic effects of standard-like nontariff measures: Analytical and methodological dimensions*. Iowa State University Working Paper 16-WP 569.

Brooks, J. 2018. The concentration of agricultural trade. *Euro Choices* 17(2): 28–29.

Bureau, J., Disdier, A., Emlinger, C., Felbermayr, G., Fontagné, L., Fouré, J. and Jean, S. 2014. *Risks and opportunities for the EU agri-food sector in a possible EU–US Trade Agreement*. CEPII Research report 2014-1-September. http://www.europarl.europa.eu/studies

Burfisher, M.E. 2011. *Introduction to computable general equilibrium models*. Cambridge: Cambridge University Press.

Burrell, A., Ferrari, E., Mellado, A.G., Himics, M., Michalek, J., Shrestha, S. and Van Doorslaer, B. 2011. *Potential EU-Mercosur free trade agreement: Impact assessment*. Luxembourg: Publication Office of the European Union.

CBI. 2009. *CBI market survey: The EU market for canned fruit and vegetables*. CBI Market Intelligence, Ministry of Foreign Affairs, The Hague, Netherlands.

CBI. 2015. *CBI trade statistics: Processed fruit and vegetables in Europe*. CBI Market Intelligence, Ministry of Foreign Affairs, The Hague, Netherlands.

CBI. 2018. *Exporting canned fruit and vegetables to Europe*. CBI Market Intelligence, Ministry of Foreign Affairs, The Hague, Netherlands.

Cioffi, A., Santeramo, F.G. and Vitale, C.D. 2011. The price stabilization effects of the EU entry price scheme for fruit and vegetables. *Agricultural Economics* 42(3): 405–418.

Citrus Growers Association of Southern Africa. 2011. *Annual Report 2011*. http://www.cga.co.za/Page.aspx?ID=3207

Dal Bianco, A., Boatto, V.L., Caracciolo, F. and Santeramo, F.G. 2015. Tariffs and non-tariff frictions in the world wine trade. *European Review of Agricultural Economics* 43(1): 31–57.

Disdier, A.C., Fontagné, L., and Cadot, O. 2015. North–South standards harmonization and international trade. *The World Bank Economic Review* 29(2): 327–352.

EU Parliament. 2011. *The EU fruit and vegetables sector: Overview and post 2013 CAP perspective, study*. Directorate-General for Internal Policies, Policy Department B: Structural and Cohesion Policies, Agriculture and Rural Development, Brussels.

European Commission. 2011. EU *trade of apples and pears*. https://ec.europa.eu/agriculture/fruit-and-vegetables/product-reports/apples-and-pears_en

European Commission. 2016. *Final report of an audit carried out in South Africa to evaluate the system of official controls and the certification of citrus fruit for export to the European Union*. http://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=3751

EUROPHYT. 2016. European Union notification system for plant health interceptions annual report 2016. https://ec.europa.eu/food/plant/plant_health_biosecurity/europhyt/annual_reports_en

Gebrehiwet, Y., Ngqangweni, S. and Kirsten, J.F. 2007. Quantifying the trade effect of sanitary and phytosanitary regulations of OECD countries on South African food exports. *Agrekon* 46(1): 23–39.

Gilbert, J., Furusawa, T. and Scollay, R. 2018. The economic impact of the Trans-Pacific Partnership: What have we learned from CGE simulation? *The World Economy* 41(3): 831–865.

Gonzalez-Mellado, A., Gay, S.H., M'Barek, R. and Ferrari, E. 2010. *Evaluation of non-tariff measures for African agricultural exports to the EU in a CGE framework*. https://www.researchgate.net/profile/Emanuele_Ferrari/publication/

266879250_Evaluation_of_NonTariff_Measures_for_African_agricultural_exports_to_the_EU_in_a_CGE_framework/links/5444dedd0cf2a76a3ccdab27/Evaluation-of-Non-Tariff-Measures-for-African-agricultural-exports-to-the-EU-in-a-CGE-framework.pdf

Hasha, G. 2004. *European trading arrangements in fruits and vegetables*. US Department of Agriculture, Economic Research Service, Washington DC.

Horridge, M. 2008. *SplitCom: Programs to disaggregate a GTAP sector*. Centre of Policy Studies, Monash University, Melbourne, Victoria.

Horridge, M. and Laborde, D. 2010. *TASTE a program to adapt detailed trade and tariff data to GTAP-related purposes*. Centre of Policy Studies, Monash University, Melbourne, Victoria.

Kareem, O.I. 2011. The European Union trade policies and Africa's exports. *World Economics* 12(2): 54.

Khorana, S. 2008.The developmental relevance of tariff rate quotas (TRQs) as a market access instrument: An analysis of Swiss Agricultural Imports. *Estey Centre Journal of International Law and Trade Policy* 9(2): 8–31.

Kierzenkowski, R., Gal, P., Fulop, G., Flaig, D. and van Tongeren, F. 2018. *Sectoral and regional distribution of export shocks. What do two hundred thousand UK firm observations say?* OECD Economics Department Working Papers No. 1501. OECD Publishing, Paris.

Koch, S.F. and Peet, M.A. 2007. Non-tariff barriers faced by South African firms: are there any lessons? *South African Journal of Economic and Management Sciences* 10(4): 530–543.

Kwasowski, M. 2009. *Pear processing market in the EU*. Presentation at International Pear Congress, 28–29 March, 2009. http://www.interpera.org/past-presentations-2009-2017.html

Li, X. and Carter, C.A. 2009. The impacts of tariff-rate import quotas on market access. Unpublished manuscript. Department of Agricultural and Resource Economics, University of California.

Lim, S.S. and Blandford, D. 2009. Korea's tariff rate quota system: impact of the Doha development agenda Proposals. *Journal of Korea Trade* 13(2): 1–19.

Matthews, A., Salvatici, L. and Scoppola, M. 2017. *Trade impacts of agricultural support in the EU*. No. 938-2016-74528.

Monnich, C. 2003. *Tariff rate quotas: Does administration matter?* Justus Liebig University Giessen, Center for International Development and Environmental Research (ZEU).

Narayanan, B.G., Aguiar, A. and Mcdougall, R. (eds) 2015. *Global trade, assistance, and production: The GTAP 9 data base*. Center for Global Trade Analysis, Purdue University.

Nimenya, N., Ndimira, P.F. and de Frahan, B.H. 2012. Tariff equivalents of nontariff measures: the case of European horticultural and fish imports from African countries. *Agricultural Economics* 43(6): 635–653.

Plummer, C., Cheong, D. and Hamanaka, S. 2010. *Methodology for impact assessment of free trade agreements*. Manila: Asian Development Bank.

Pouliot, S. and Larue, B. 2012. Import sensitive products and perverse tariff-rate quota liberalisation. *Canadian Journal of Economics* 45(3): 903–924.

PPECB. 2013. *Annual Report 2012/2013.* https://ppecb.com/document-category/annual-reports/

Santeramo, F.G. and Cioffi, A. 2012. The entry price threshold in EU agriculture: Deterrent or barrier? *Journal of Policy Modeling* 34(5): 691–704.

Sinopoli, D. and Purnhagen, K.P. 2016. When life gives you lemons: The battle of science on the correct interpretation of data on citrus black spot disease between the European Union and South Africa according to the SPS Agreement. *Trade Law and Development* 8(1): 29.

TARIC. 2018. *Tariff quota consultation*. http://ec.europa.eu/taxation_customs/dds2/taric/quota_consultation.jsp?Lang=en&Origin=ZA&Code=091811&Year=2015&Year=2014&Year=2013&Year=2012&Critical=&Status=&Expand=true.

Trade Map. 2018. *Trade statistics of South African fruit products to the EU and the world*. International Trade Centre, Geneva. http://www.trademap.org/

WTO. 2016. *Activities of the SPS Committee and other relevant WTO activities in 2015*. https://www.ippc.int/en/publications/82242/

Appendices

Appendix 1. Trade flow weights of fruit/fruit products tariff lines in the GTAP OFD sector

TDCA fruit TRQ	New GTAP sector code	HS 6-digit tariff line code	Trade flow weights in the GTAP OFD sector
Frozen orange juice	FROZJUCE	HS2009.11	0.00535
Canned pears, apricots and peaches	PAP	HS2008.40	0.000597
		HS2008.50	0.000519
		HS2008.70	0.002323
Frozen strawberries	STRAWBRY	HS0811.10	0.002347
Apple, pineapple juice	APLEPINE	HS2009.41	0.000761
		HS2009.49	0.001561
		HS2009.71	0.001142
		HS2009.79	0.006999
Canned fruit mixtures	FRUITMIX	HS2009.92	0.002496
TOTAL weight for OTHER_OFD			0.975905

Source: Author compilation based on sector trade flow sourced from TASTE program.

Appendix 2. Model closures and shocks.

Experiment	Endogenous variables and swaps	Exogenous variables	Shock
GTAP standard closure	Rest Endogenous	pop psaveslack pfactwld profitslack incomeslack endwslack cgdslack tradslack ams atm atf ats atd aosec aoreg avasec avareg afcom afsec afreg afecom afesec afereg aoall afall afeall au dppriv dpgov dpsave to tp tm tms tx txs qo (ENDW_COMM,REG)	pfactwld = uniform 10
Altertax simulation to create 2011 benchmark database with TDCA fruit TRQ in-quota and out-of quota tariffs	dtbalr("SOUTH_AFRICA") dtbalr("EU_28") cgdslack ("RestofWorld") Rest Endogenous	pop psaveslack pfactwld profitslack incomeslack endwslack tradslack ams atm atf ats atd aosec aoreg avasec avareg afcom afsec afreg afecom afesec afereg aoall afall afeall au dppriv dpgov dpsave to tp tm tms tx txs qo(ENDW_COMM,REG)	tms("FROZJUCE","SOUTH_AFRICA","EU_28") = 1.6369; tms("FROZJUCE","RestofWorld","EU_28") = 8.0110; tms("PAP","SOUTH_AFRICA","EU_28") = 2.9462; tms("PAP","RestofWorld","EU_28") = 10.4487; tms("STRAWBRY","SOUTH_AFRICA","EU_28") = –5.8045; tms("STRAWBRY","RestofWorld","EU_28") = 7.2610; tms("APLEPINE","SOUTH_AFRICA","EU_28") = 3.5962; tms("APLEPINE","RestofWorld","EU_28") = 14.6117; tms("FRUITMIX","SOUTH_AFRICA","EU_28") = 2.6260; tms ("FRUITMIX","RestofWorld","EU_28") = 9.8862;
TRQ expansion using the rate of growth of actual export	Rest Endogenous swap tms (TRAD_COMM,REG, REG) = qxs (TRAD_COMM,REG, REG);	pop psaveslack pfactwld profitslack incomeslack endwslack cgdslack tradslack ams atm atf ats atd aosec aoreg avasec avareg afcom afsec afreg afecom afesec afereg aoall afall afeall au dppriv dpgov dpsave to tp tm tms tx txs qo (ENDW_COMM,REG)	qxs("FROZJUCE","SOUTH_AFRICA","EU_28") = 60.97; qxs("PAP","SOUTH_AFRICA","EU_28") = –8.53; qxs("STRAWBRY","SOUTH_AFRICA","EU_28") = 0; qxs("APLEPINE","SOUTH_AFRICA","EU_28") = –66.10; qxs("FRUITMIX","SOUTH_AFRICA","EU_28") = –17.56;

Source: Own compilation based on GTAP model.

Appendix 2. Model closures and shocks – continued

Experiment	Endogenous variables and Swaps	Exogenous variables	Shock
100% TRQ fill	Rest Endogenous swap tms (TRAD_COMM,REG, REG) = qxs (TRAD_COMM,REG, REG);	pop psaveslack pfactwld profitslack incomeslack endwslack cgdslack tradslack ams atm atf ats atd aosec aoreg avasec avareg afcom afsec afreg afecom afesec afereg aoall afall afeall au dppriv dpgov dpsave to tp tm tms tx txs qo(ENDW_COMM,REG)	qxs("FROZJUCE","SOUTH_AFRICA","EU_28") = 1.82; qxs("PAP","SOUTH_AFRICA","EU_28") = 1.34; qxs ("APLEPINE","SOUTH_AFRICA","EU_28") = 2; qxs("FRUITMIX","SOUTH_AFRICA","EU_28") = 4.97;
100% tariff liberalisation for TRQs except frozen strawberries	Rest Endogenous	pop psaveslack pfactwld profitslack incomeslack endwslack cgdslack tradslack ams atm atf ats atd aosec aoreg avasec avareg afcom afsec afreg afecom afesec afereg aoall afall afeall au dppriv dpgov dpsave to tp tm tms tx txs qo(ENDW_COMM,REG)	tms("FROZJUCE","SOUTH_AFRICA","EU_28") = -7.3216; tms("PAP","SOUTH_AFRICA","EU_28") = -8.5003; tms("APLEPINE","SOUTH_AFRICA","EU_28") = -9.0744; tms("FRUITMIX","SOUTH_AFRICA","EU_28") = -8.2148;
Reduction of trade costs accounted for by NTMs	Rest Endogenous	pop psaveslack pfactwld profitslack incomeslack endwslack cgdslack tradslack ams atm atf ats atd aosec aoreg avasec avareg afcom afsec afreg afecom afesec afereg aoall afall afeall au dppriv dpgov dpsave to tp tm tms tx txs qo(ENDW_COMM,REG)	ams("FROZJUCE","SOUTH_AFRICA","EU_28") = 64; ams("PAP","SOUTH_AFRICA","EU_28") = 64; ams("STRAWBRY","SOUTH_AFRICA","EU_28") = 64; ams("APLEPINE","SOUTH_AFRICA","EU_28") = 64; ams ("FRUITMIX","SOUTH_AFRICA","EU_28") = 64;
Quota expansion by 3% through an equivalent shock to the power of the tariff	Rest Endogenous	pop psaveslack pfactwld profitslack incomeslack endwslack cgdslack tradslack ams atm atf ats atd aosec aoreg avasec avareg afcom afsec afreg afecom afesec afereg aoall afall afeall au dppriv dpgov dpsave to tp tm tms tx txs qo(ENDW_COMM,REG)	tms("FROZJUCE","SOUTH_AFRICA","EU_28") = -0.75221; tms("PAP","SOUTH_AFRICA","EU_28") = -0.75219; tms("STRAWBRY","SOUTH_AFRICA","EU_28") = -0.752218; tms("APLEPINE","SOUTH_AFRICA","EU_28") = -0.75225; tms("FRUITMIX","SOUTH_AFRICA","EU_28") = -0.75216;

Source: Own compilation based on GTAP model